SIRA and scattering in the IPM
Appendix

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Dayton Jones kindly provided me with a sample ALFA configuration, a distribution of 16 antennas in a spherical shell of 100 km diameter.

o As a zeroeth order exercise, I produced 5 scaled versions of Dayton's array. The array diameters were 2, 5, 10, 20, and 50 km.

o Snapshot uv data bases were then produced for each array at a frequency of 1 MHz.

o A source model was passed through the instrument. The model was a simple Gaussian with a FWHM angular size of 5 degrees (consistent with the ISEE-3 results of Steinberg et al 1985 and my simple PWE calculations).

o The source flux was arbitrarily chosen to be 1 Jy.

o Note: the data were noiseless.

The result, briefly, is as follows:

As can be seen, the 5 km array is best matched to the source size. The 2 km under-resolves the source while the 10 km array over-resolves the source. The 20 and 50 km arrays grossly over-resolve the source.

Comments:

It may be possible to use elongated configurations that can satisfy both solar and astrophysical mapping requirements, but given the fact that solar source mapping must be supported to large solar elongations (90o?) this must be studied carefully.

An alternative is that the array can be reconfigured in time, beginning with a compact configuration and slowly moving to a larger configuration.

Regardless of the solution adopted, these simple calculations are meant to be illustrative only. Much, much more work needs to be done along these lines.
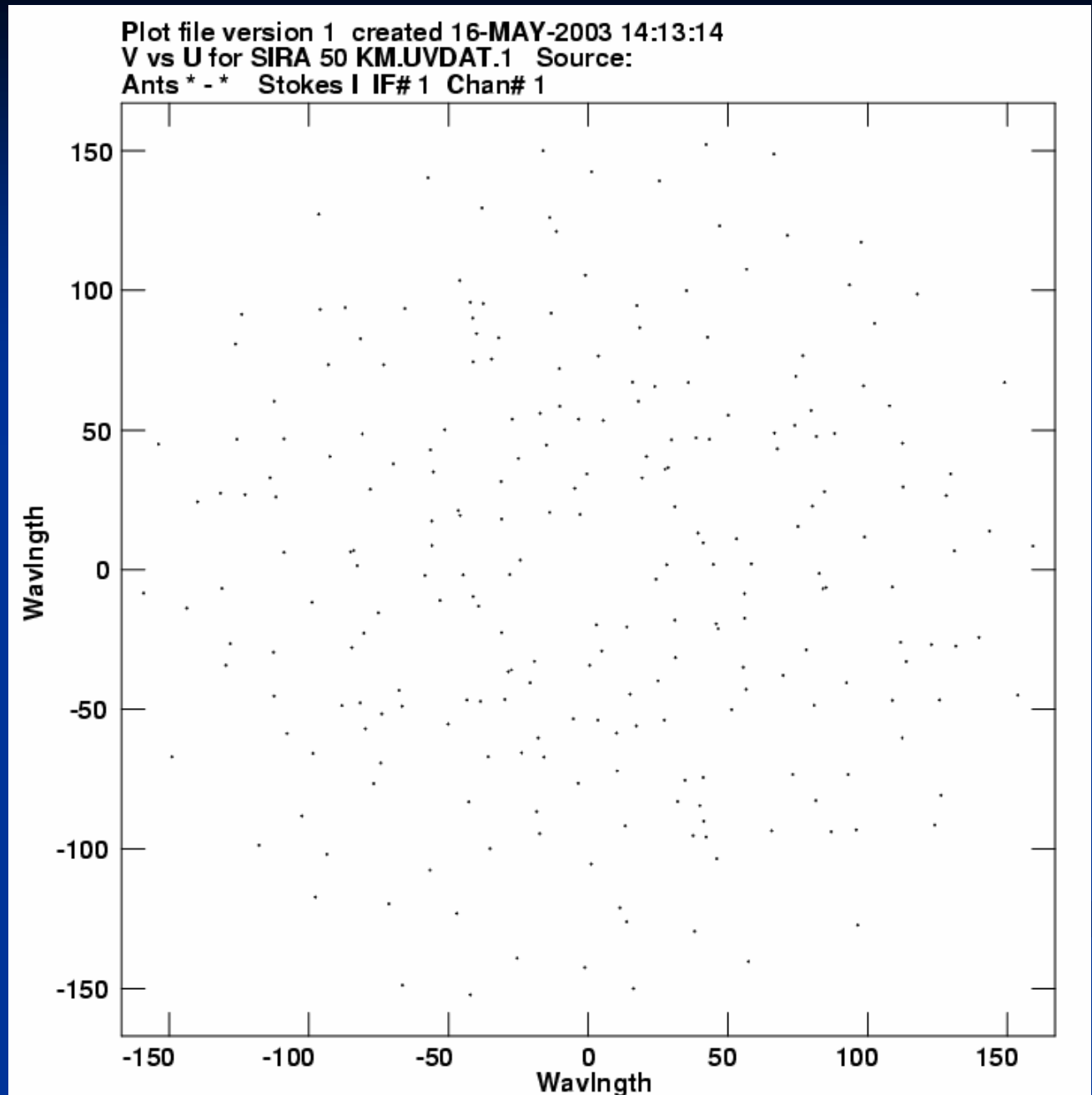
o Model (projected) uv coverage for a spherical array 50 km in diameter.

o In the uv domain, it samples baselines up to 166 λ.

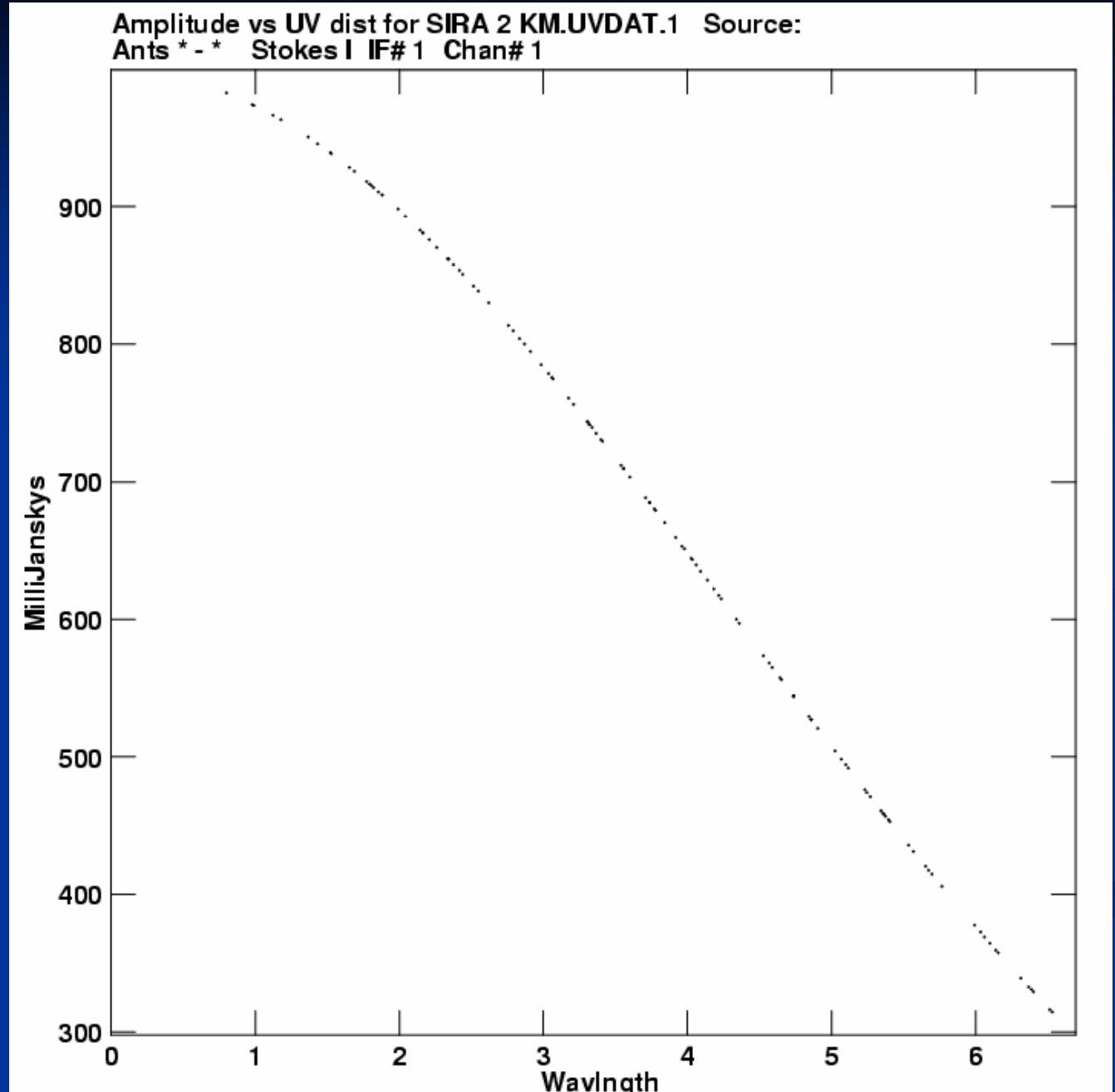o Approximately uniform coverage is apparent.

o All other arrays are scaled versions of this one.

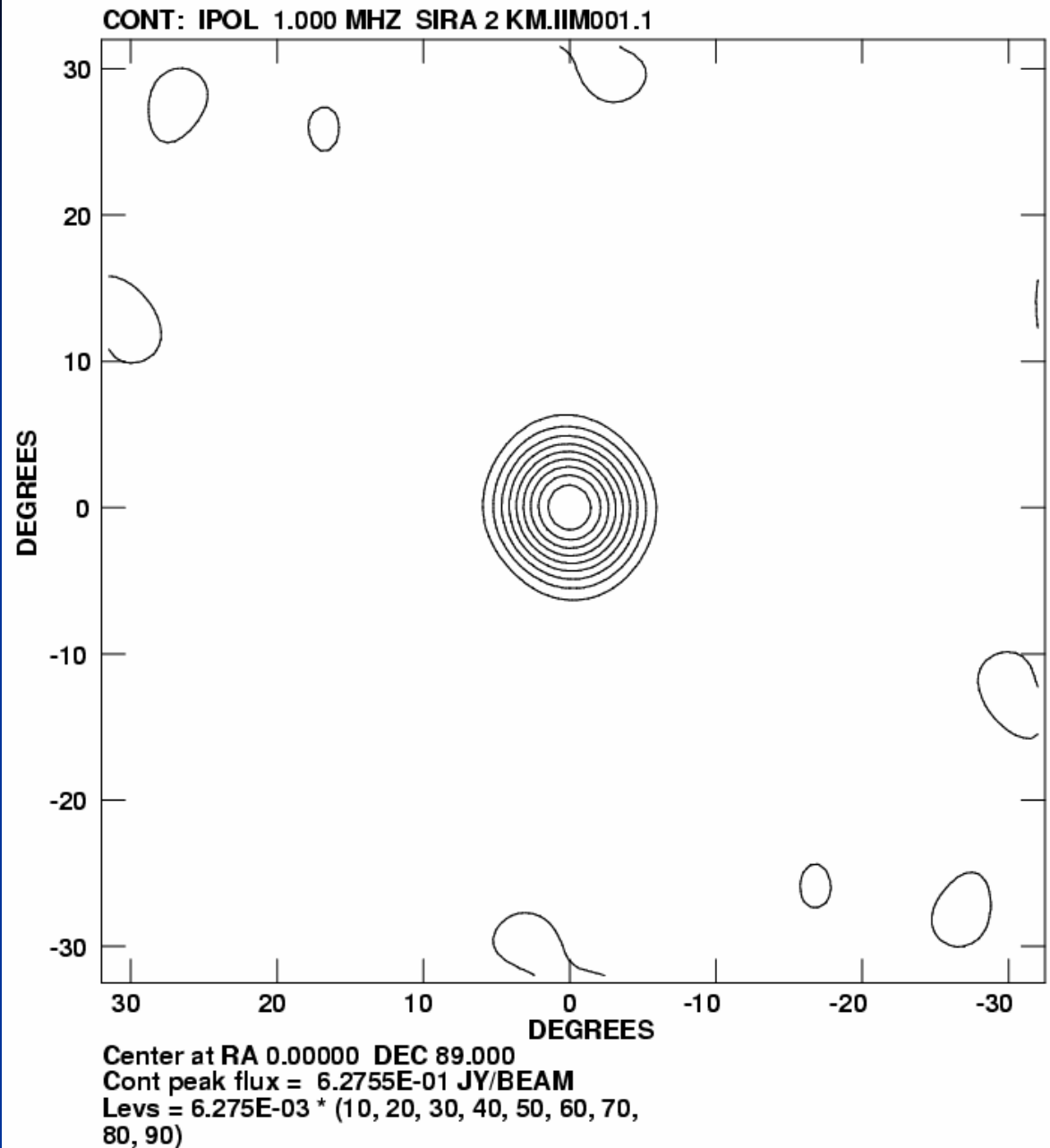o The most compact is 2 km, yielding a maximum baseline of only ~6 wavelengths.

Plot file version 1 created 16-MAY-2003 14:13:14
V vs U for SIRA 50 KM.UVDAT.1 Source:
Ants * - *   Stokes I IF# 1 Chan# 1

2 km array

Visibility amplitude as a function of uv distance. Recall that the total source flux is 1 Jy.

Amplitude vs UV dist for SIRA 2 KM.UVDAT.1   Source:
Ants * - *   Stokes I IF# 1   Chan# 1

2 km array

Dirty map (i.e., no deconvolution) of the model source.
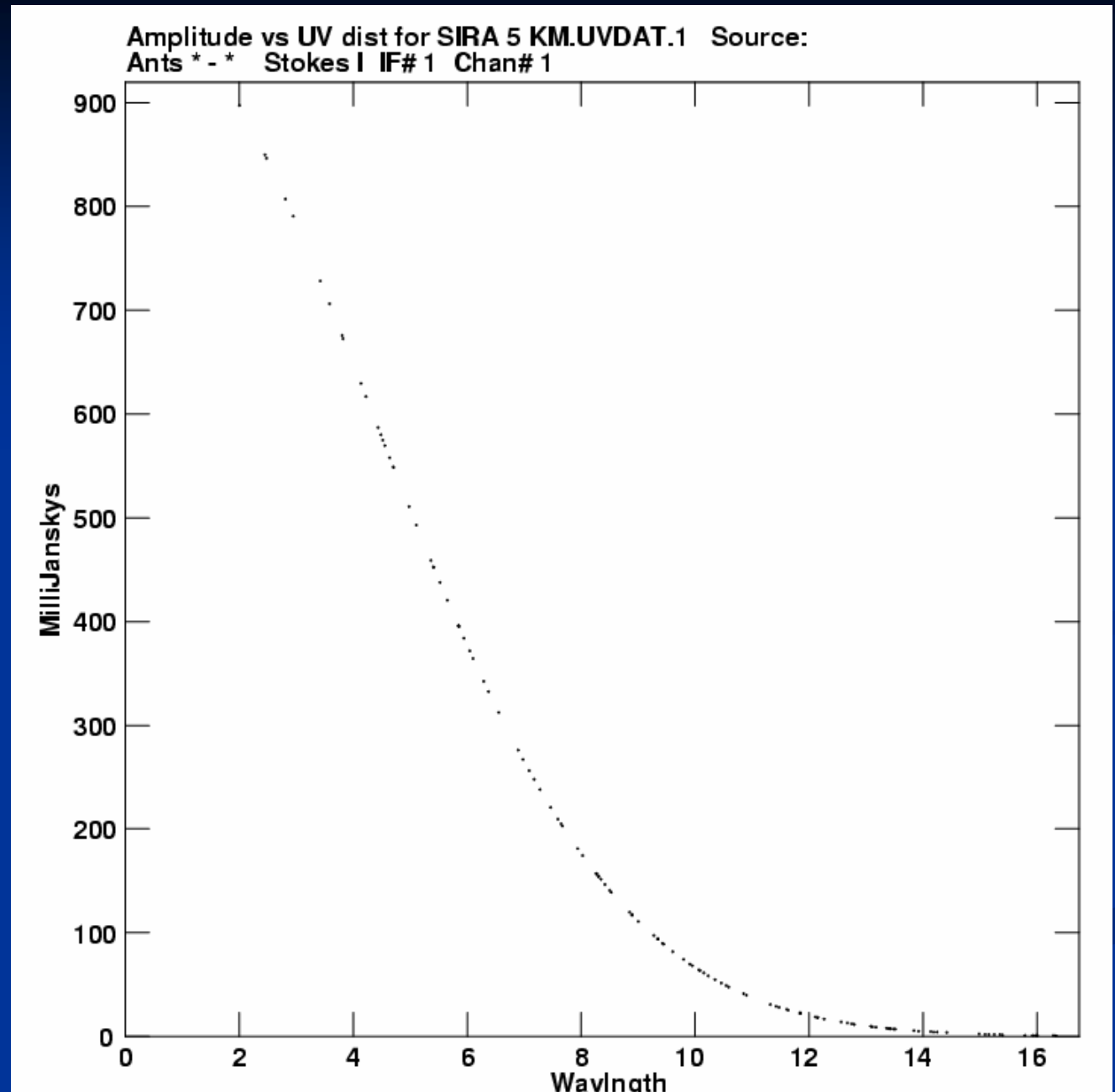
CONT: IPOL 1.000 MHZ SIRA 2 KM.IIM001.1

Center at RA 0.00000 DEC 89.000
Cont peak flux = 6.2755E-01 JY/BEAM
Levs = 6.275E-03 * (10, 20, 30, 40, 50, 60, 70, 80, 90)

5 km array

Visibility amplitude as a function of uv distance.

Amplitude vs UV dist for SIRA 5 KM.UVDAT.1   Source:
Ants * - *   Stokes I IF# 1   Chan# 1

5 km array

Dirty map of the model source.

CONT: IPOL 1.000 MHZ SIRA 5 KM.IIM001.1

Center at RA 0.00000 DEC 89.000
Cont peak flux = 1.9642E-01 JY/BEAM
Levs = 1.964E-03 * (10, 20, 30, 40, 50, 60, 70, 80, 90)

10 km array

Visibility amplitude as a function of uv distance.

Amplitude vs UV dist for SIRA 10 KM.UVDAT.1   Source:
Ants * - *   Stokes I IF# 1   Chan# 1
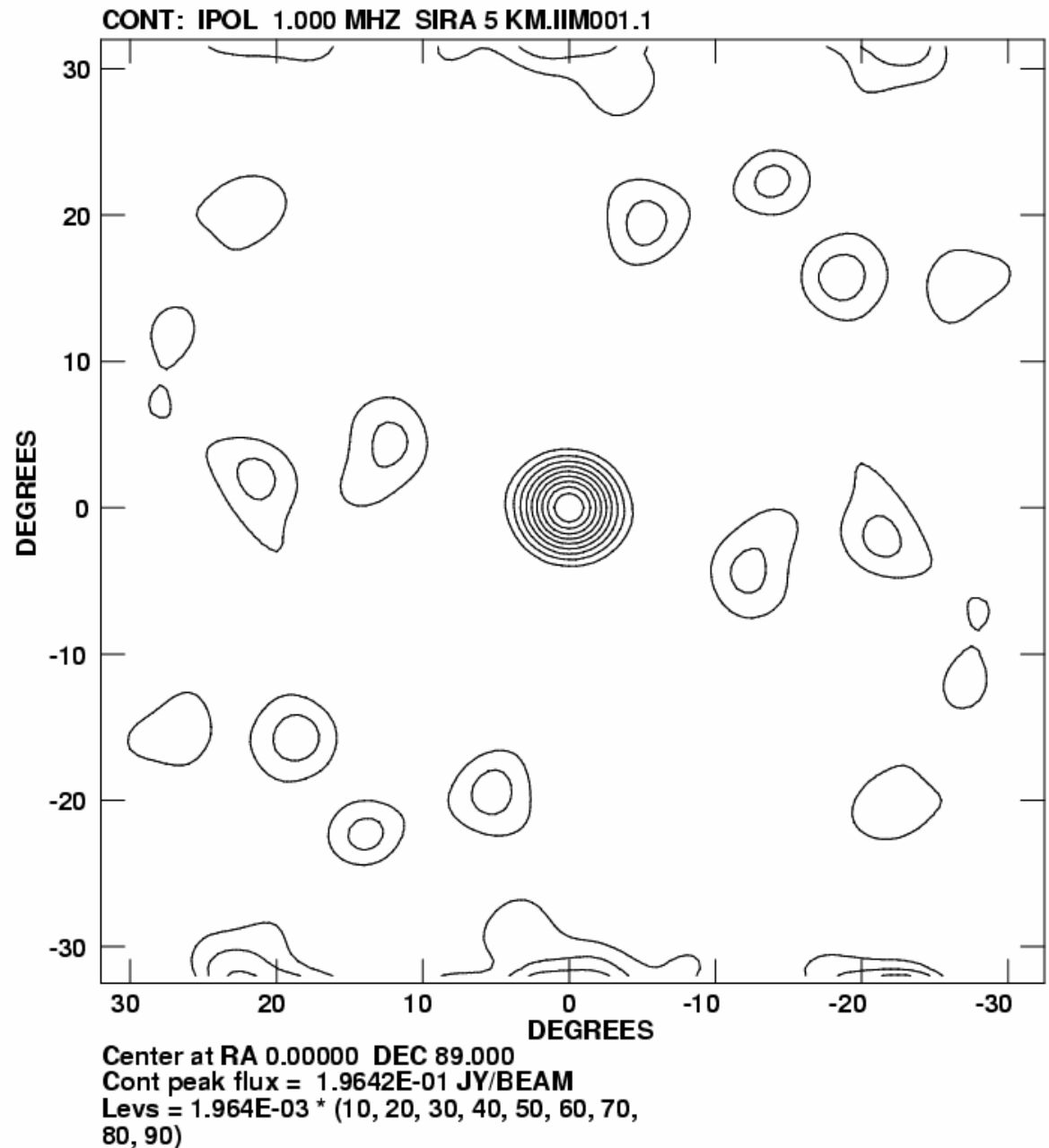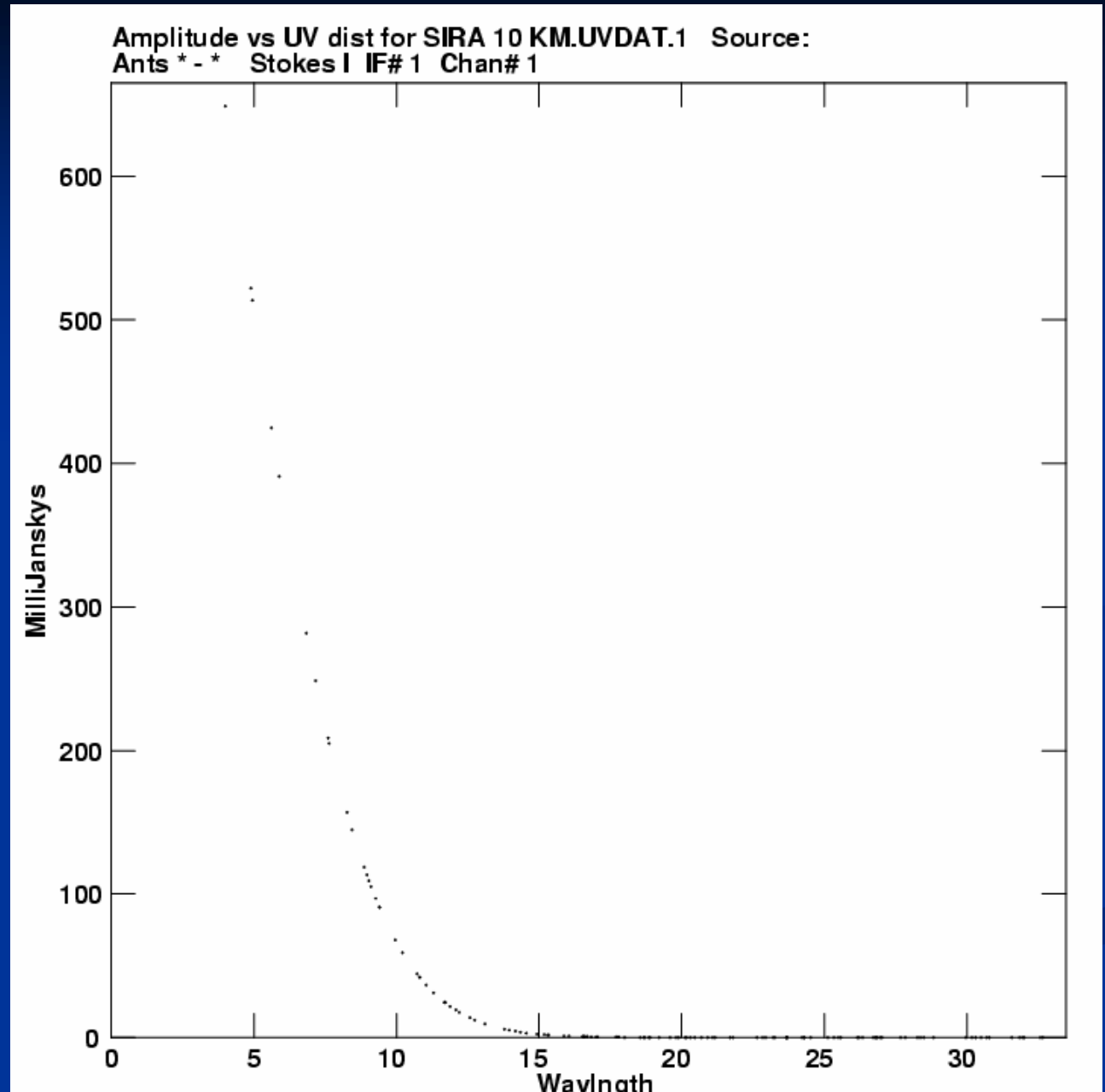
10 km array

Dirty map of the model source.

Note that the sidelobe level is as high as 50%.

A significant amount of source flux has been resolved out.

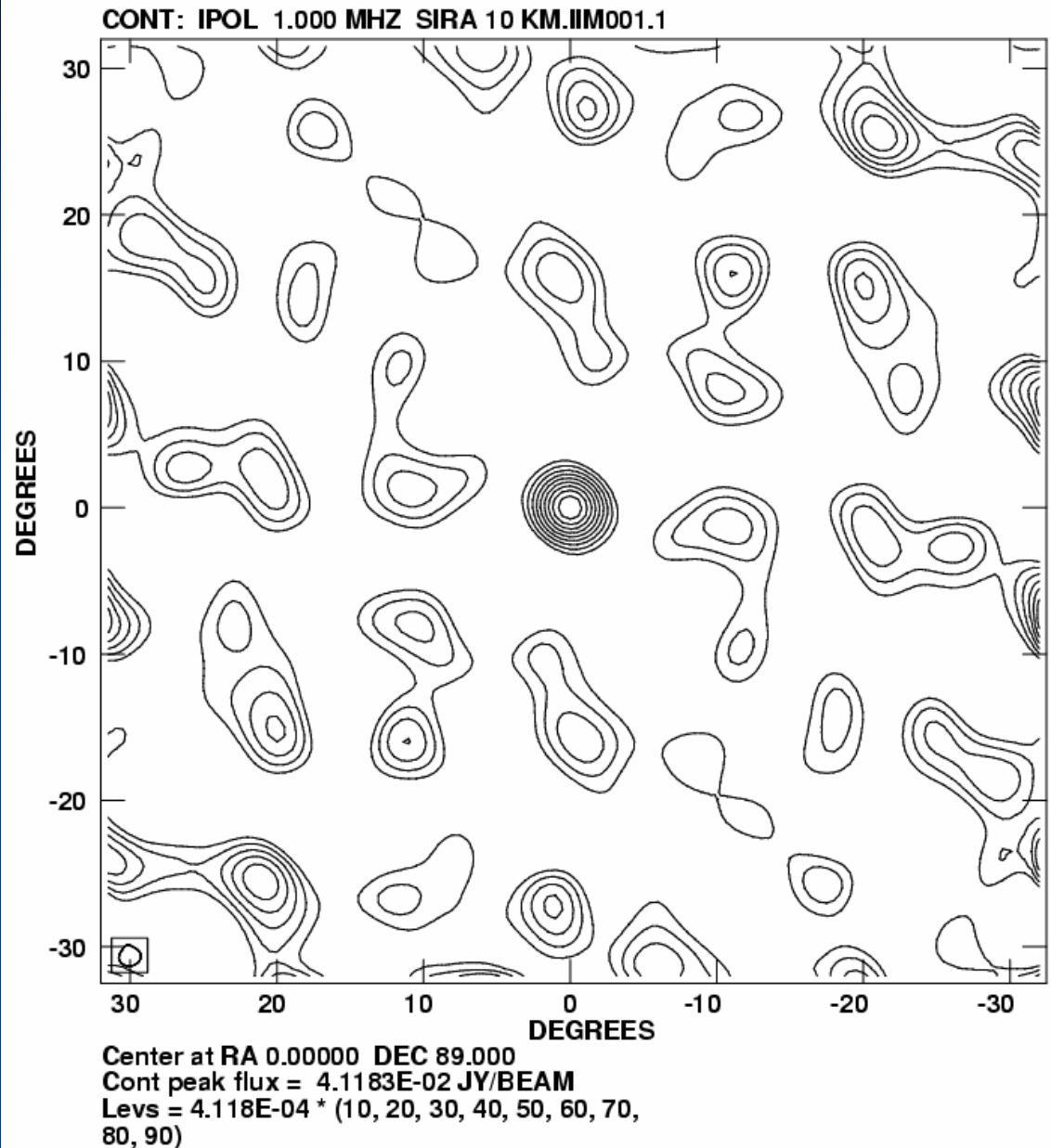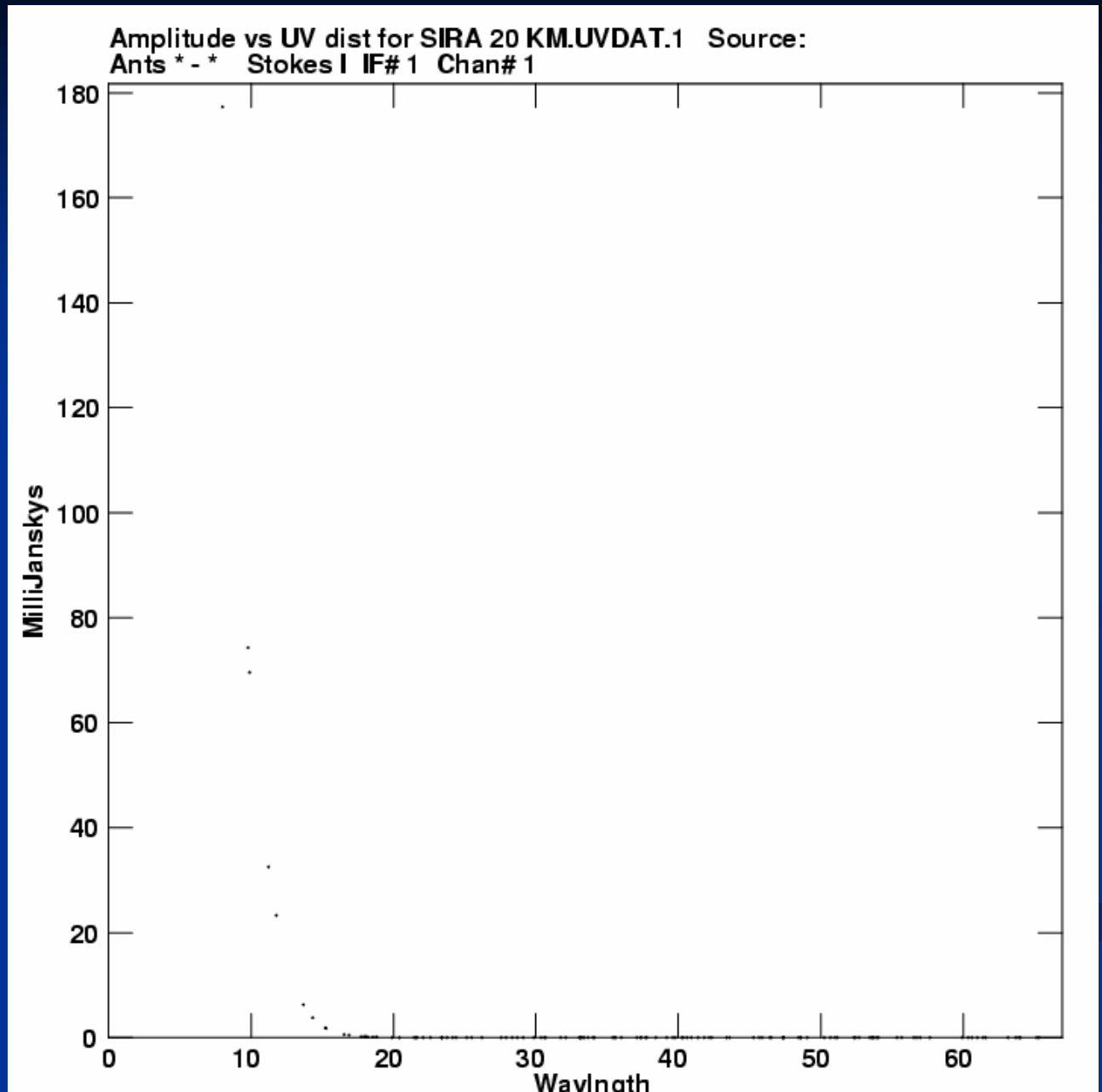# 20 km array

Visibility amplitude as a function of uv distance.

Only ~10% of the baselines see correlated flux.

The source is grossly over-resolved.

Amplitude vs UV dist for SIRA 20 KM.UVDAT.1   Source:
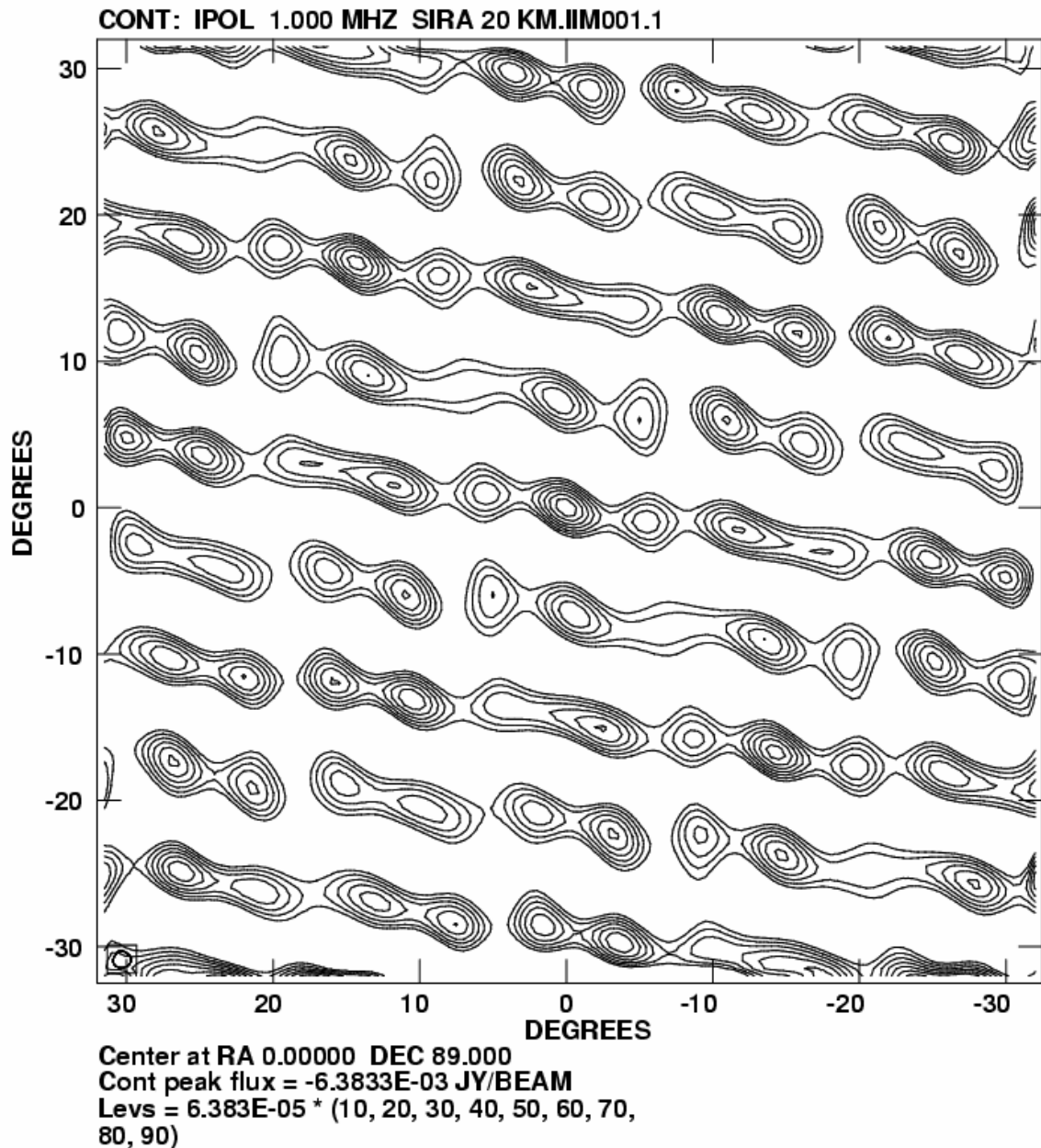Ants * - *   Stokes I IF# 1 Chan# 1

20 km array

Dirty map of the model source.

Without prior knowledge, the source is largely indistinguishable from the sidelobes.

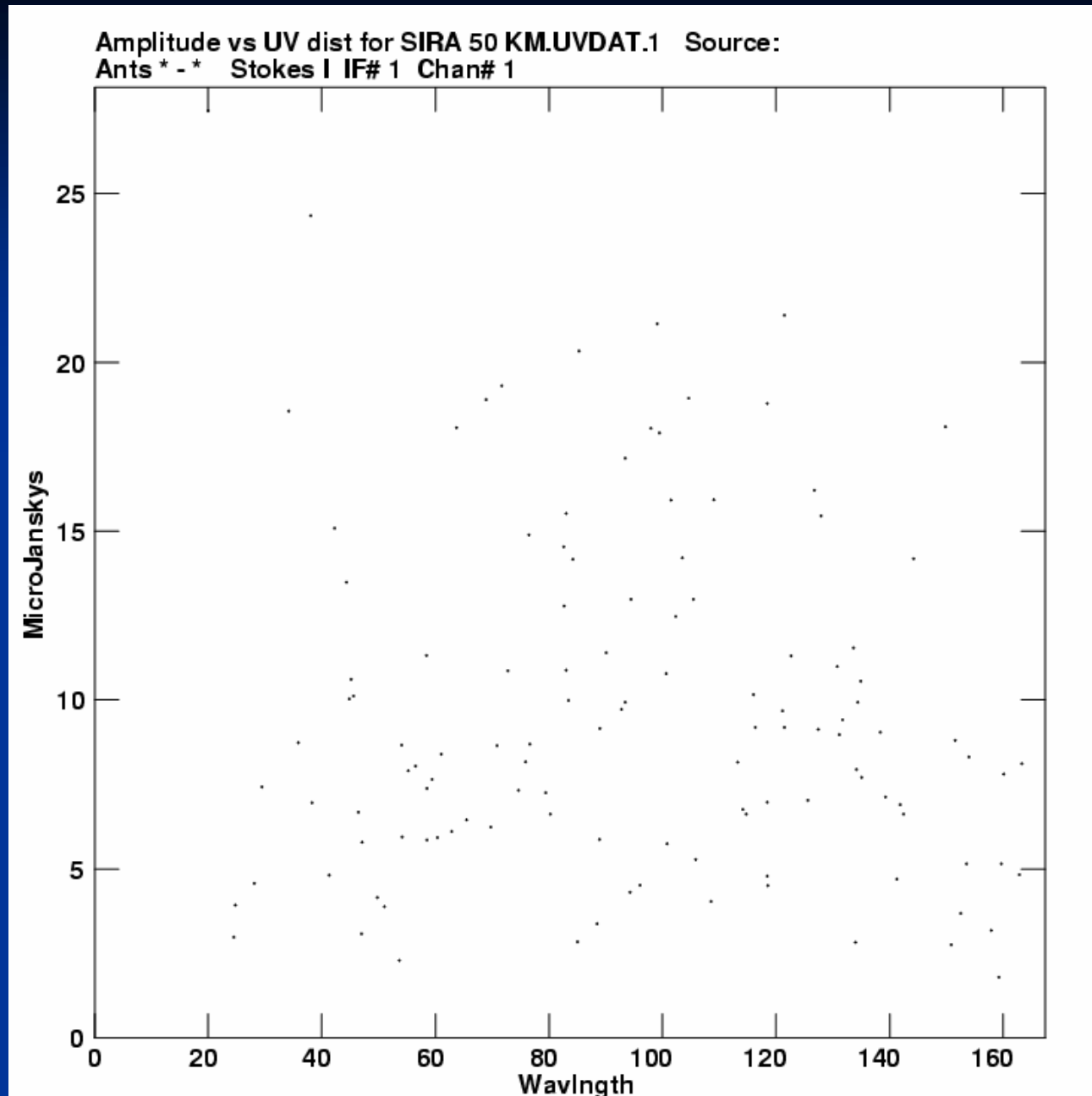Most of the source flux is resolved out.

CONT: IPOL 1.000 MHZ SIRA 20 KM.IIM001.1

Center at RA 0.00000 DEC 89.000
Cont peak flux = -6.3833E-03 JY/BEAM
Levs = 6.383E-05 * (10, 20, 30, 40, 50, 60, 70, 80, 90)

50 km array

Visibility amplitude as a function of uv distance.

There is no correlated flux seen on any baseline, only (numerical) noise.

Amplitude vs UV dist for SIRA 50 KM.UVDAT.1   Source:
Ants * - *   Stokes I IF# 1 Chan# 1

50 km array

Dirty map of the model source.

No source is present, just numerical noise.

CONT: IPOL 1.000 MHZ SIRA 50 KM.IIM001.1

Center at RA 0.00000 DEC 89.000
Cont peak flux = -1.1729E-05 JY/BEAM
Levs = 1.173E-07 * (10, 20, 30, 40, 50, 60, 70, 80, 90)